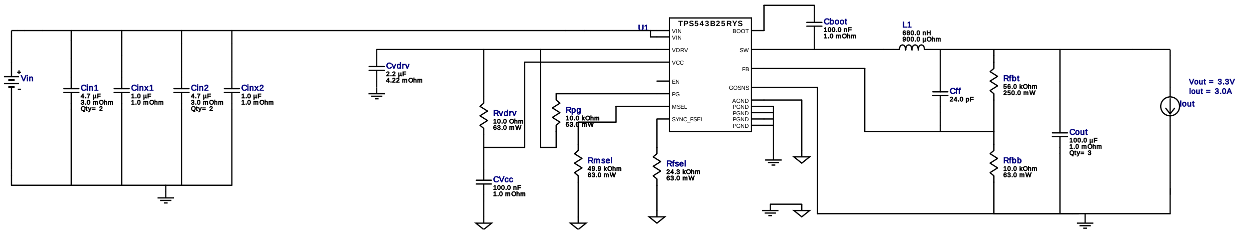
TEXAS INSTRUMENTS

VinMin = 4.5V
VinMax = 7.4V
Vout = 3.3V
Iout = 3.0A

Device = TPS543B25RYS
Topology = Buck
Created = 2025-03-05 08:08:09.260
BOM Cost = $5.78
BOM Count = 21
Total Pd = 0.23W

WEBENCH ® Design Report

Design : 34 TPS543B25RYS
TPS543B25RYS 4V-12V to 1.00V @ 25A

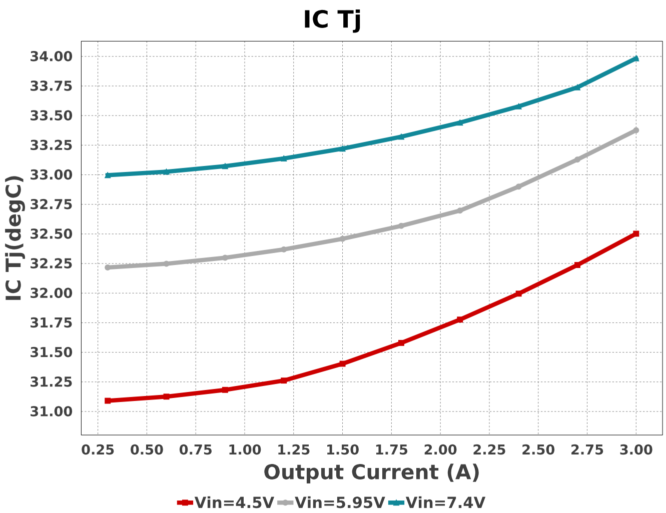


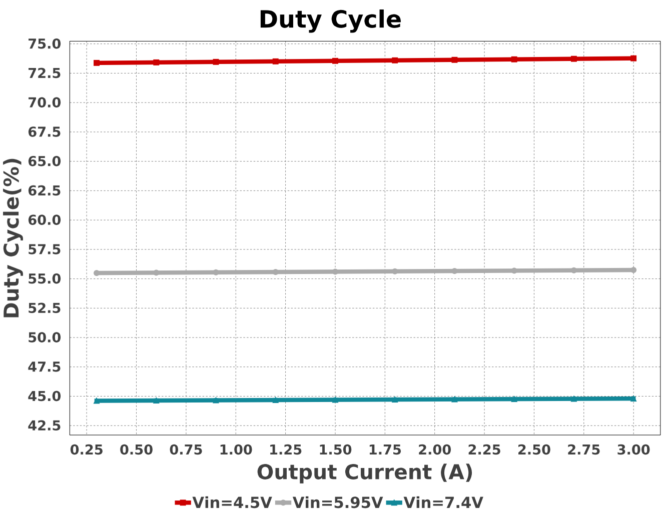
1.

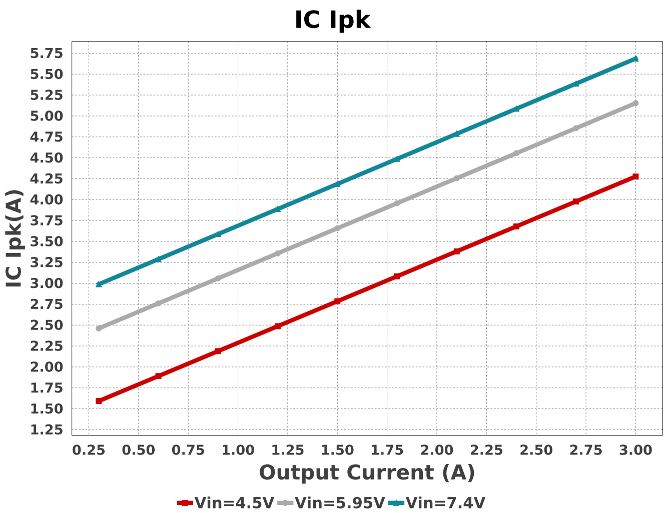
Electrical BOM

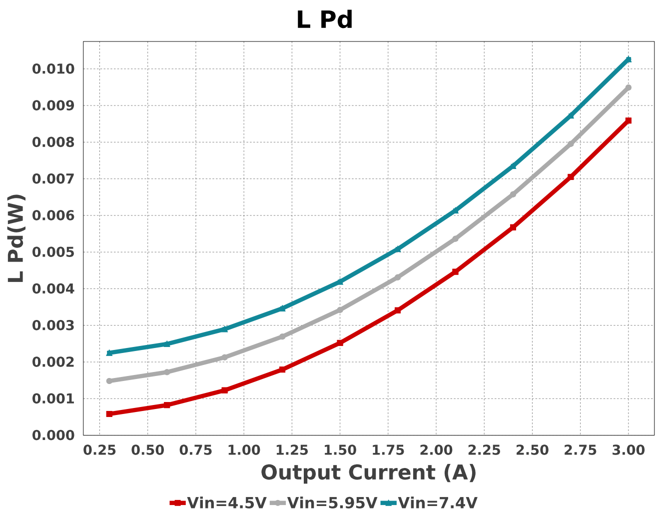
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
CVcc	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cff	Kemet	C0402C240J3GACTU Series= C0G/NP0	Cap= 24.0 pF VDC= 25.0 V IRMS= 0.0 A	1	$0.08	0402 3 mm^2
Cin1	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	2	$0.10	1206 11 mm^2
Cin2	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	2	$0.10	1206 11 mm^2
Cinx1	Taiyo Yuden	EMK107B7105KA-T Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cinx2	Taiyo Yuden	EMK107B7105KA-T Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cout	MuRata	GRM32EC80J107ME20L Series= X6S	Cap= 100.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	3	$0.17	1210_270 15 mm^2
Cvdrv	MuRata	GRM21BR71A225KA01L Series= X7R	Cap= 2.2 uF ESR= 4.22 mOhm VDC= 10.0 V IRMS= 2.08454 A	1	$0.03	0805 7 mm^2
L1	Coilcraft	XAL1010-681MEB	L= 680.0 nH 900.0 µOhm	1	$1.71	XAL1010 160 mm^2

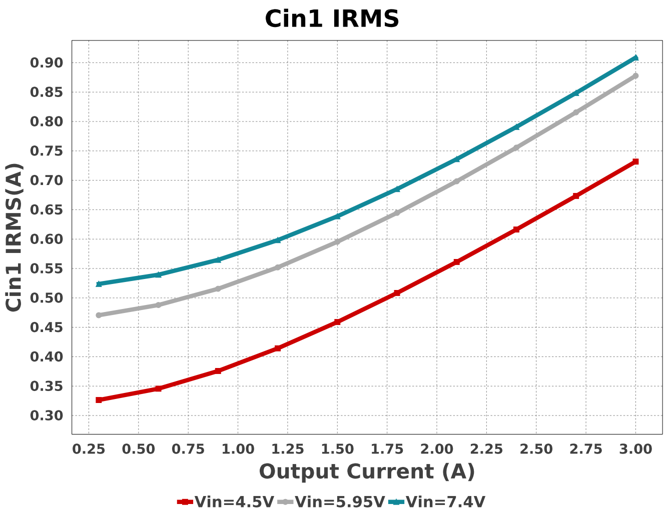
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Yageo	RC1206FR-0756KL Series= ?	Res= 56.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm^2
Rfsel	Vishay-Dale	CRCW040224K3FKED Series= CRCW..e3	Res= 24.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rmsel	Vishay-Dale	CRCW040249K9FKED Series= CRCW..e3	Res= 49.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rpg	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rvdrv	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	TPS543B25RYS	Switcher	1	$2.95	RYS0015A-MFG 19 mm^2

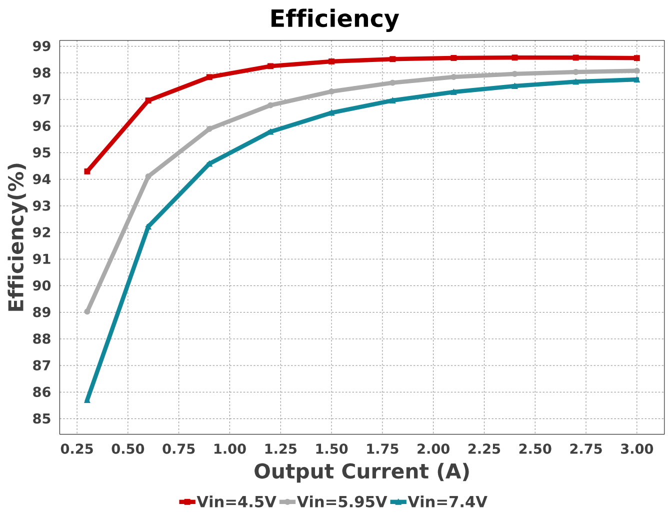


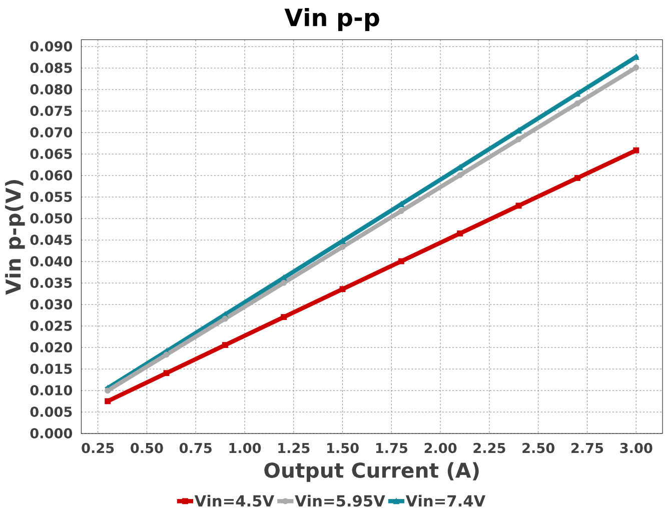


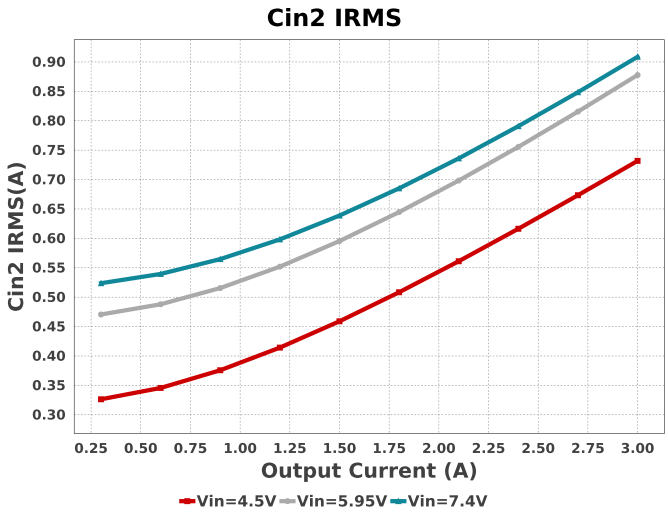


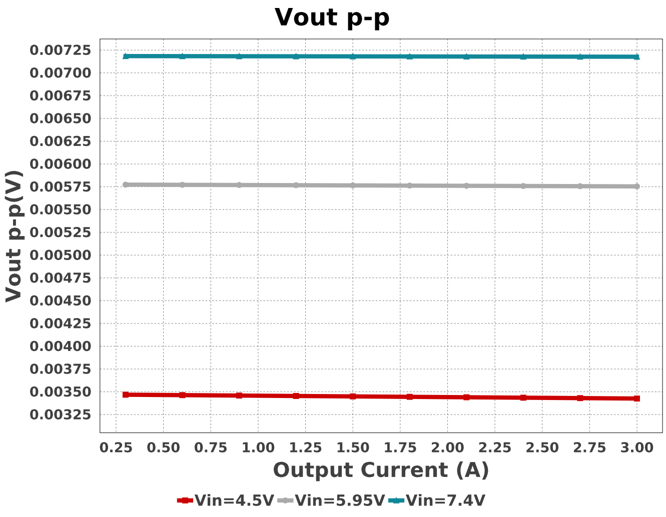


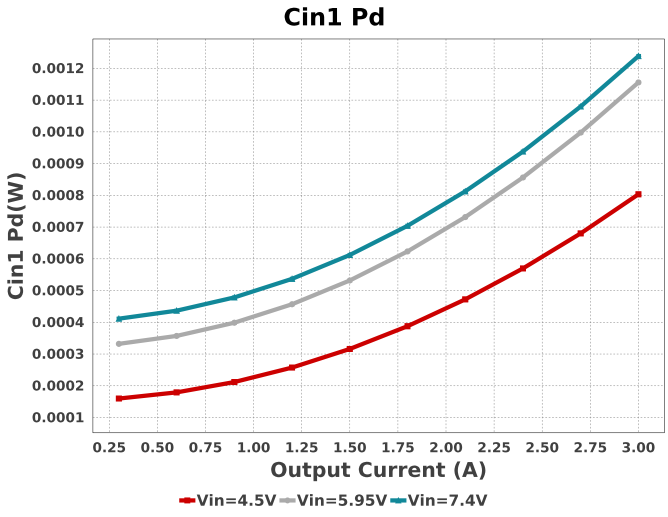

Cin1 IRMS
Cin1 IRMS(A)
Output Current (A)
Vin=4.5V Vin=5.95V Vin=7.4V

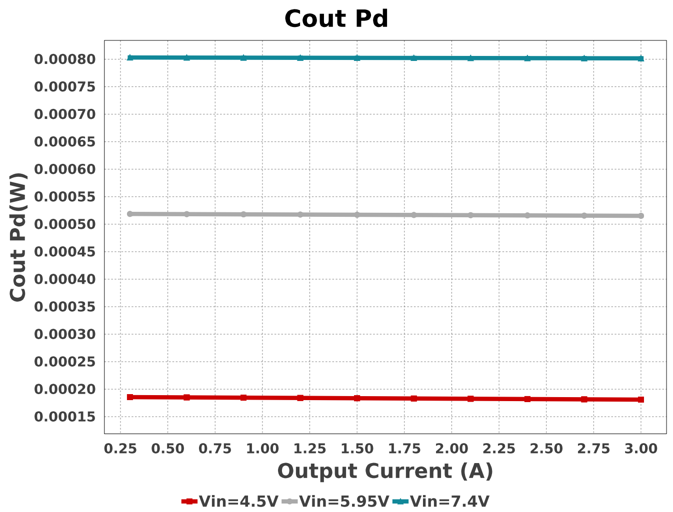

Efficiency
Efficiency(%)
Output Current (A)
Vin=4.5V Vin=5.95V Vin=7.4V

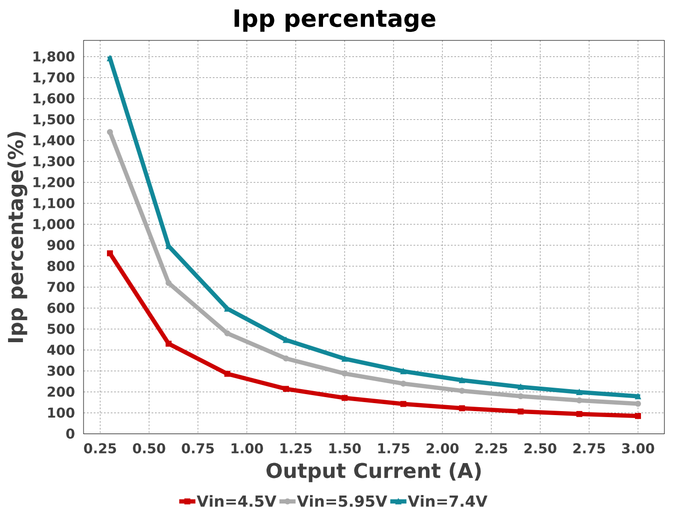

Vin p-p
Vin p-p(V)
Output Current (A)
Vin=4.5V Vin=5.95V Vin=7.4V

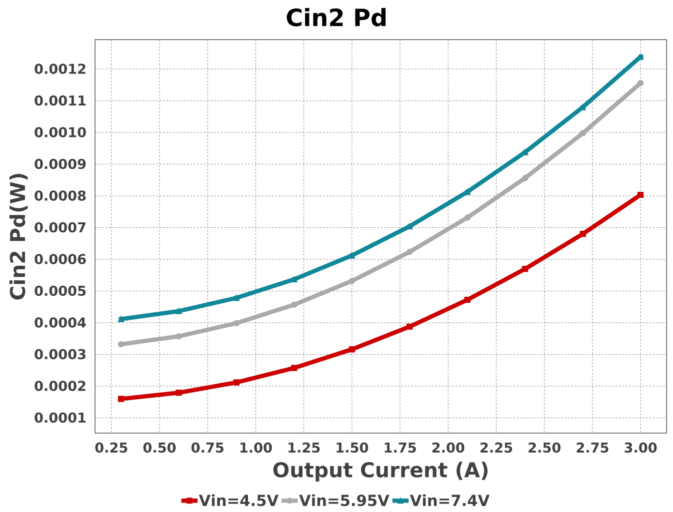

Cin2 IRMS
Cin2 IRMS(A)
Output Current (A)
Vin=4.5V Vin=5.95V Vin=7.4V

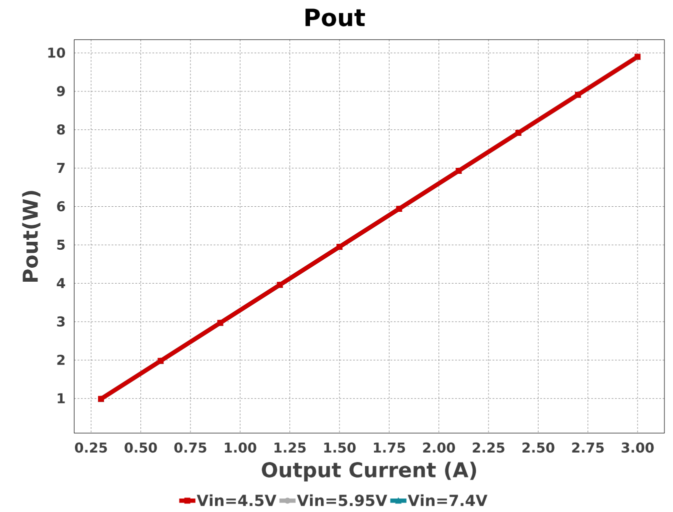

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=4.5V Vin=5.95V Vin=7.4V

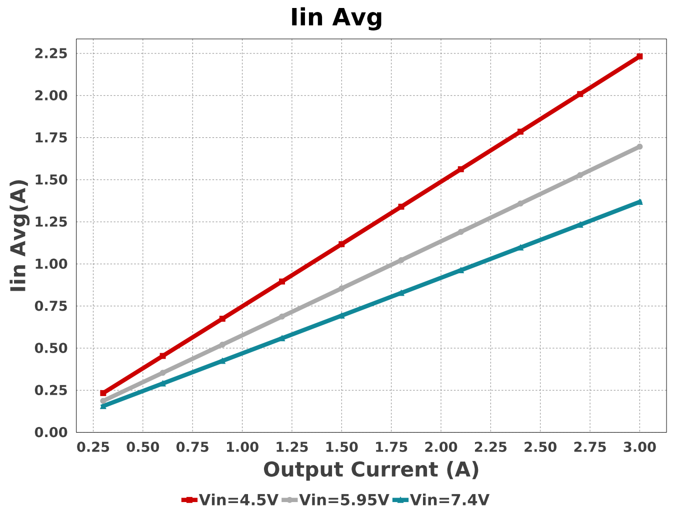

Cin1 Pd
Cin1 Pd(W)
Output Current (A)
Vin=4.5V Vin=5.95V Vin=7.4V

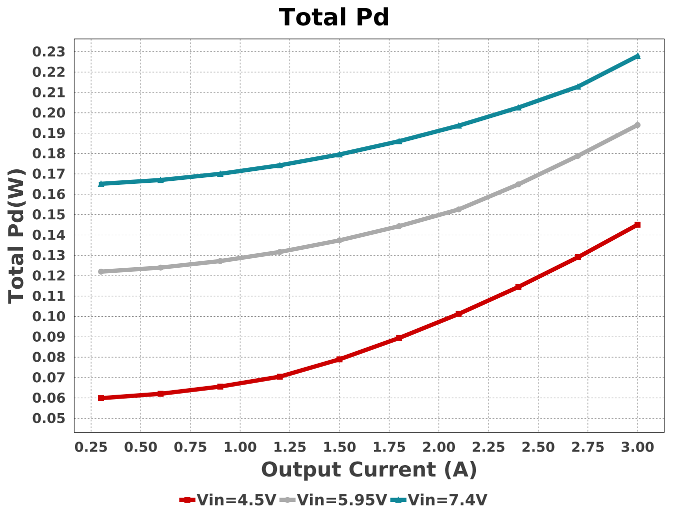

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=4.5V
Vin=5.95V
Vin=7.4V

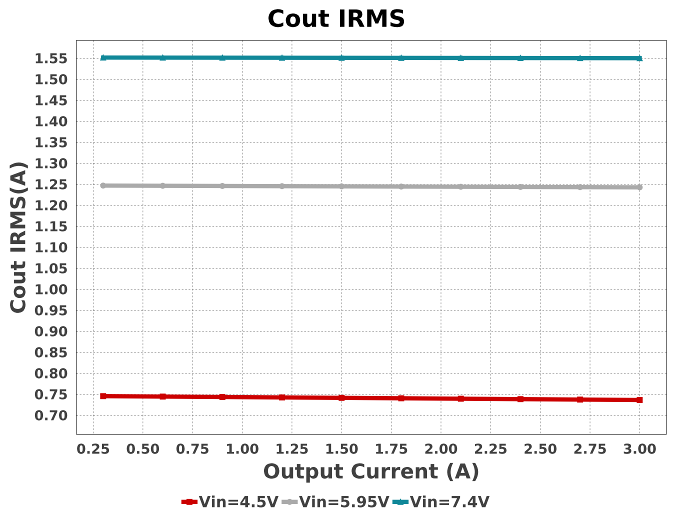

Ipp percentage
Ipp percentage(%)
Output Current (A)
Vin=4.5V
Vin=5.95V
Vin=7.4V

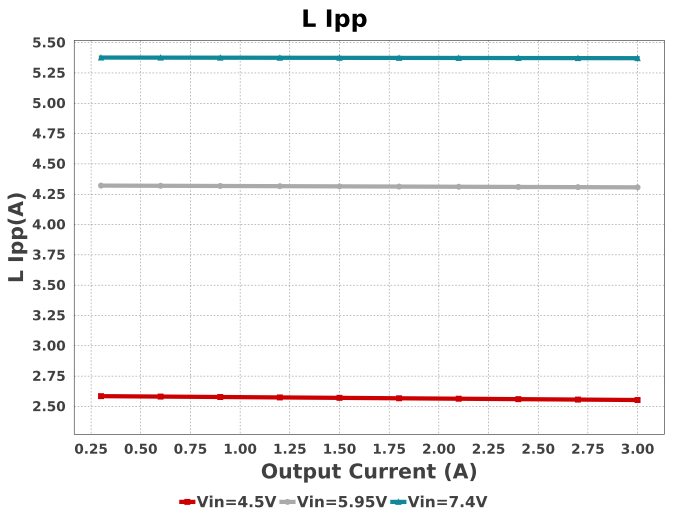

Cin2 Pd
Cin2 Pd(W)
Output Current (A)
Vin=4.5V
Vin=5.95V
Vin=7.4V

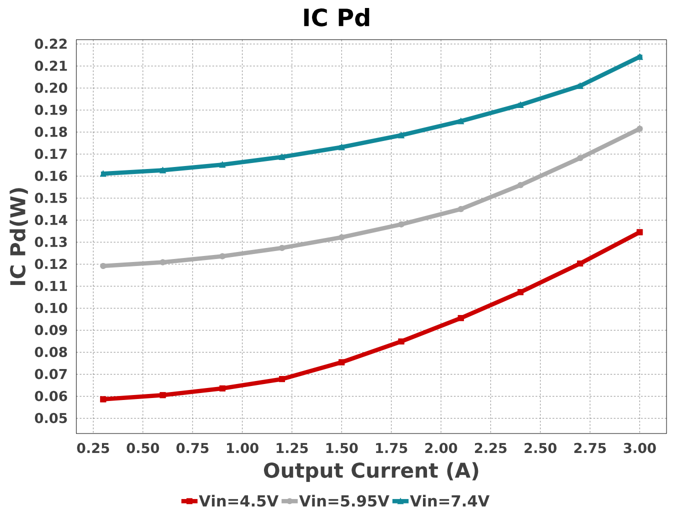

Pout
Pout(W)
Output Current (A)
Vin=4.5V
Vin=5.95V
Vin=7.4V

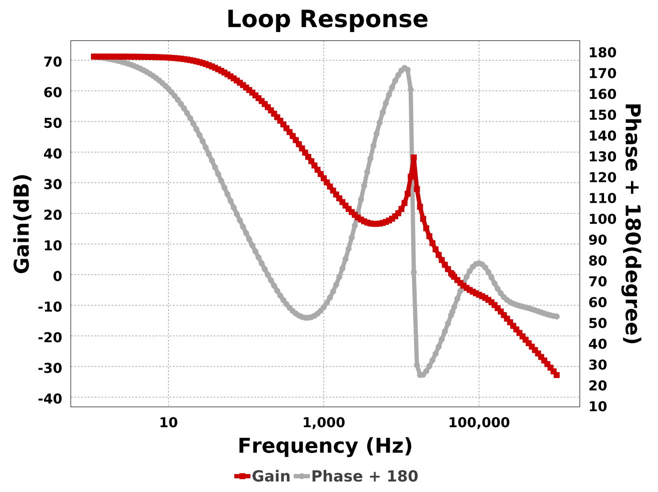

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=4.5V
Vin=5.95V
Vin=7.4V


Total Pd
Total Pd(W)
Output Current (A)
Vin=4.5V
Vin=5.95V
Vin=7.4V









Operating Values

#	Name	Value	Category	Description
1.	Cin1 IRMS	908.72 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin1 Pd	1.239 mW	Capacitor	Input capacitor power dissipation
3.	Cin2 IRMS	908.72 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin2 Pd	1.239 mW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	1.551 A	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	801.59 µW	Capacitor	Output capacitor power dissipation
7.	Total Cin ESR	1.5 mOhm	Capacitor	Cin Capacitor ESR
8.	Total Cout ESR	333.333 µOhm	Capacitor	Cout Capacitor ESR
9.	Cramp	2.0 pF	IC	Selected Cramp for setting Ramp amplitude
10.	IC Ipk	5.686 A	IC	Peak switch current in IC
11.	IC Pd	214.18 mW	IC	IC power dissipation
12.	IC Tj	33.984 degC	IC	IC junction temperature
13.	IC Tolerance	5.0 mV	IC	IC Feedback Tolerance
14.	ICThetaJA Effective	18.6 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
15.	Iin Avg	1.369 A	IC	Average input current
16.	Ipp percentage	179.063 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
17.	L Ipp	5.372 A	Inductor	Peak-to-peak inductor ripple current
18.	L Pd	10.264 mW	Inductor	Inductor power dissipation
19.	L1 DCR	900.0 µOhm	Inductor	L1 DCR
20.	Cin1 Pd	1.239 mW	Power	Input capacitor power dissipation
21.	Cin2 Pd	1.239 mW	Power	Input capacitor power dissipation
22.	Cout Pd	801.59 µW	Power	Output capacitor power dissipation
23.	IC Pd	214.18 mW	Power	IC power dissipation
24.	L Pd	10.264 mW	Power	Inductor power dissipation
25.	Total Pd	227.872 mW	Power	Total Power Dissipation
26.	BOM Count	21	System Information	Total Design BOM count
27.	Cross Freq	45.429 kHz	System Information	Bode plot crossover frequency
28.	Duty Cycle	44.803 %	System Information	Duty cycle

#	Name	Value	Category	Description
29.	Efficiency	97.75 %	System Information	Steady state efficiency
30.	FootPrint	318.0 mm^2	System Information	Total Foot Print Area of BOM components
31.	Frequency	500.0 kHz	System Information	Switching frequency
32.	Gain Marg	-65.822 dB	System Information	Bode Plot Gain Margin
33.	Inductor ripple current requirement used for Inductor selection	30.0 %	System Information	Custom Inductor ripple current (% of average inductor current) requirement used for Inductor selection
34.	Iout	3.0 A	System Information	Iout operating point
35.	Iout transient step used for Cout calculations	750.0 mA	System Information	Custom Transient current step requirement that was used for Cout selection (A).
36.	Low Freq Gain	71.175 dB	System Information	Gain at 1Hz
37.	Mode	CCM	System Information	Conduction Mode
38.	Overshoot Value	304.77 µV	System Information	Theoretical Vout Overshoot Value
39.	Peak Over current Limit HS FET(Maximum)	30.45 A	System Information	Over current protection threshold
40.	Peak Over current Limit HS FET(Minimum)	27.55 A	System Information	Over current protection threshold
41.	Peak Over current Limit HS FET(typical)	29.0 A	System Information	Over current protection threshold
42.	Phase Marg	55.573 deg	System Information	Bode Plot Phase Margin
43.	Pout	9.9 W	System Information	Total output power
44.	Total BOM	$5.78	System Information	Total BOM Cost
45.	Undershoot Value	4.616 mV	System Information	Theoretical Vout Undershoot Value
46.	Vin	7.4 V	System Information	Vin operating point
47.	Vin Ripple requirement used for Cin calculations	5.0 %	System Information	Custom maximum input ripple requirement that was used for Cin selection(% of Minimum Vin).
48.	Vin p-p	87.591 mV	System Information	Peak-to-peak input voltage
49.	Vout Actual	3.3 V	System Information	Vout Actual calculated based on selected voltage divider resistors
50.	Vout Ripple requirement used for Cout calculations	1.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
51.	Vout Tolerance	2.731 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
52.	Vout p-p	7.177 mV	System Information	Peak-to-peak output ripple voltage
53.	Vout transient requirement used for Cout calculations	4.0 %	System Information	Custom Transient voltage change requirement that was used for Cout selection (% of Vout).

Design Inputs

Name	Value	Description
Iout	3.0	Maximum Output Current
VinMax	7.4	Maximum input voltage
VinMin	4.5	Minimum input voltage
Vout	3.3	Output Voltage
base_pn	TPS543B25	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	500.0	Customer Selected Frequency

WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of Cin and Cout, and the inductance and DC resistance of L1 before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

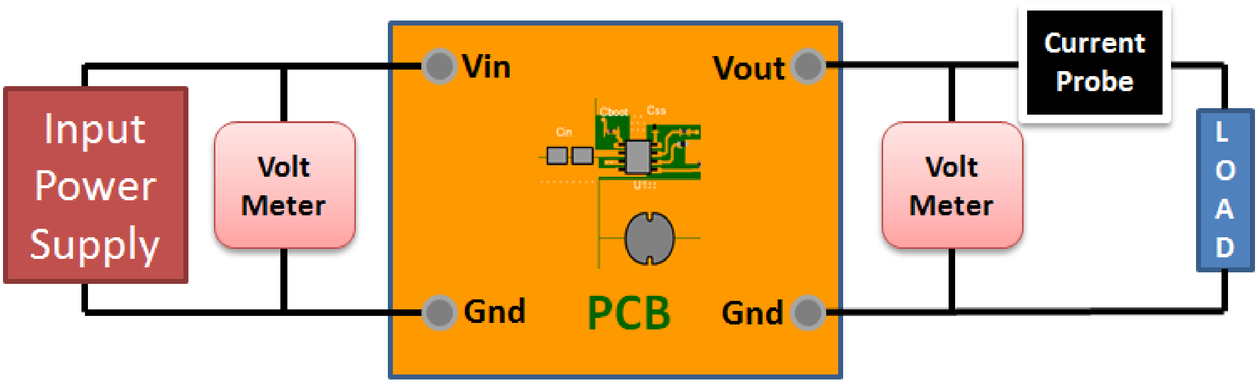
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 4.5V and set the input supply's current limit to zero. With the input supply off connect up the input supply to Vin and GND. Connect a digital volt meter and a load if needed to set the minimum Iout of the design from Vout and GND. Turn on the input supply and slowly turn up the current limit on the input supply.
If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between Vin and GND, a load is connected between Vout and GND and a current meter is connected in series between Vout and the load. The load must be able to handle at least rated output power + 50% (7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.

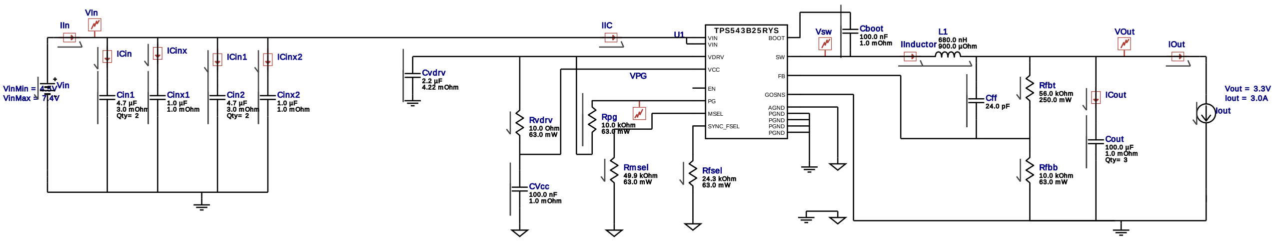


WEBENCH® Electrical Simulation Report

Design Id = 34

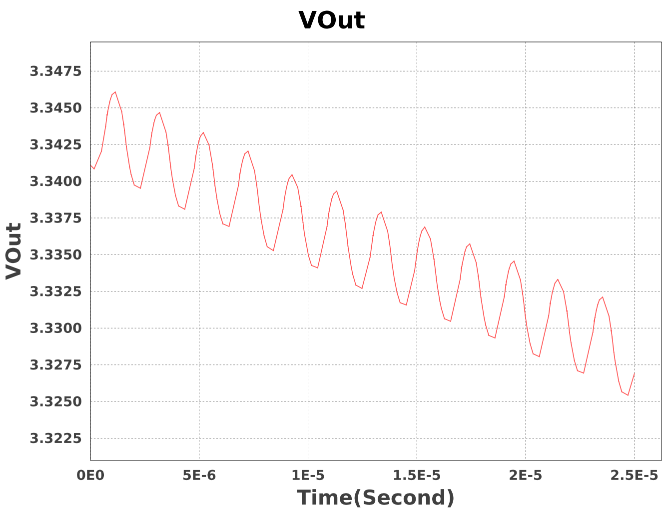
sim_id = 2

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cvdrv	IC	no description	0
2.	Cin1	IC	inputvoltage	5.95
3.	L1	IC	Initial Current	3.0
4.	Cinx2	IC	no description	5.95
5.	Cinx1	IC	no description	5.95
6.	Cout	IC	Vout	3.3
7.	Cin2	IC	no description	5.95
8.	Iout	I	Output Current	3.0



Design Assistance

1. Master key : 27AFC3A06A218B6F8EA41ED3B4C0DDB7[v1]

2. **TPS543B25** Product Folder : http://www.ti.com/product/TPS543B25 : contains the data sheet and other resources.

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